IN THE UNITED STATES PATENT & TRADEMARK OFFICE

Applicant(s) Kenneth Boyd, et al.

Serial Number: 10/707,365 Group Art Unit: 2128

Filing Date: December 9, 2003 Examiner: Hugh M. Jones

Title: Method and Apparatus for Controlling a Vehicle Computer Model with Oversteer

Attorney Docket Number: 81044284

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_____7/10/09_____ ____/Lisa E. Brown/_____

Lisa E. Brown

APPELLANTS' BRIEF ON APPEAL

Sir:

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I. Statement of Real Party in Interest

The inventor or inventors listed above have assigned their rights in the invention and the present application to Ford Global Technologies, LLC.

II. Related Appeals and Interferences

An Appeal Brief was filed July 27, 2007 for 10/707,368 (Appeal No. 2009-4119) and is awaiting Appeal Board review.

A Notice of Appeal was filed April 22, 2009 for 10/707,366. The Appeal Brief is due June 22, 2009.

III. Status of Claims

Claims 1-3, 7-12 and 16-29 are under appeal. Claims 4-6 and claims 16-27 were canceled in an amendment filed December 23, 2009. Claims 1-3, 7-12 and 16-29 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,859,713 to Pallot.

IV. Status of Amendments

An Amendment filed September 22, 2008 was entered by the Examiner. A response to a Final office Action with no amendments to the claims was filed on February 9, 2009. A response to an Advisory Action with no amendments to the claims was filed on March 6, 2009.

V. Summary of Claimed Subject Matter

Claims 1-3, 7-12 and 16-29 are pending in the application. Claims 1, 12 and 21 are independent. Claims 2-11 depend from claim 1. Claims 16-20 depend from Claim 12. Claims 22-29 depend, either directly or indirectly, from Claim 21.

The present invention teaches and claims a simulation system and method that is used to test the dynamics of an automotive vehicle. The method is specifically directed to a vehicle model that is operated in an aggressive, or limit-seeking, manner. Current technology in computer vehicle models is directed to maintaining the vehicle within predetermined, or otherwise known, operating conditions that are directed to avoiding undesired steering conditions such as understeer and over steer. Because of this limitation, known computer models produce undesirable results when the model exceeds "known" limits. For example, the computer model may generate undesirable steering wheel to compensate for variations in the desired path when a vehicle is being operated in an aggressive manner. Therefore, the results output are not usable and are useless in any assessment of vehicle handling for such events. The present invention provides meaningful results, specifically under conditions when the vehicle model is pushed aggressively, and is purposely driven in the presence of understeer.

In order to accomplish this, the present invention teaches and claims in claim 1(ii)(d) and claim 12(e) that when the vehicle computer model is determined to be understeering, the vehicle computer model is operated with the initial steering wheel angle until a new steering wheel angle is determined such that plowing or slipping is reduced. In claim 21(d), the present invention teaches and claims that when the vehicle computer model is determined to be understeering, operating the vehicle computer model at one of a plurality of steering wheel angles until a later

one of the plurality of steering wheel angles is determined such that plowing or slipping forward is thereby reduced.

The independent claims are presented as follows with reference to the figures, element number and paragraph in the specification as filed:

1. A simulation system {Fig. 2, element 30, ¶0022} for simulating operation of an automotive vehicle, said simulation system comprising:

(i) an input device {Fig. 2, element 34, ¶0022} for providing vehicle information and path information; and

(ii) a controller {Fig. 2, element 38, ¶0024} coupled to said input device and operable to simulate said automotive vehicle using a vehicle computer model {Fig. 2, element 40, ¶0024}, wherein said controller is programmed to:

(a) determine an initial steering wheel angle {Fig. 4, element 78, ¶0029} that is input to said vehicle computer model;

(b) determine a new steering wheel angle {Fig. 4, element 78, ¶0029}, which is input to said vehicle computer model at a time later than said initial steering wheel angle {Fig. 4, element 76, ¶0029}, by comparing an intended vehicle path with a look ahead point on said intended vehicle path {Fig. 5, element 72, ¶0029};

(c) determine whether said vehicle computer model is understeering {Fig. 5, element 100, ¶0032} due to the front of said vehicle computer model plowing or slipping substantially forward in response to said new steering wheel angle;

(d) when said vehicle computer model is determined to be understeering {Fig. 5, element 100, ¶0032}, operate said vehicle computer model with said initial steering wheel angle until a new steering wheel angle is determined such that said plowing or slipping substantially forward is thereby reduced {Fig. 5, element 102, ¶0032};

(e) when said plowing or slipping substantially forward is reduced by a new steering wheel angle, operate said vehicle computer model with said new steering wheel angle {Fig. 5, element 110, ¶0033}; and

(f) generate an output in response to said vehicle computer model and said initial steering wheel angle or said new steering wheel angle {Fig. 5, element 114, ¶0033}.

12. (Previously Presented) A method of operating a vehicle computer model having vehicle information and path information therein, said method being operable on a digital computer system and comprising the steps of:

(a) determining an initial steering wheel angle that is input to said vehicle computer model {Fig. 4, element 78, ¶0029};

(b) determining a new steering wheel angle {Fig. 4, element 78, ¶0029}, which is input to said vehicle computer model at a time later than said initial steering wheel angle {Fig. 4, element 76, ¶0029}, by comparing an intended vehicle path with a look ahead point on said intended vehicle path {Fig. 5, element 72, ¶0029};

(c) determining whether said vehicle computer model is understeering {Fig. 5, element 100, ¶0032} due to the front of said vehicle computer model plowing or slipping substantially forward in response to said new steering wheel angle;

(d) determining whether said vehicle computer model is plowing or slipping substantially forward based on whether a yaw acceleration is greater than a predetermined threshold and also whether said new steering wheel angle is greater than said initial steering wheel angle or a previously determined new steering wheel angle {Fig. 5, element 84, ¶0029, 0030};

(e) when said vehicle computer model is determined to be understeering {Fig. 5, element 100, ¶0032}, operating said vehicle computer model with said initial steering wheel angle until a new steering wheel angle is determined such that said plowing or slipping substantially forward is thereby reduced {Fig. 5, element 90, ¶0031};

(f) when said plowing or slipping substantially forward is reduced by a new steering wheel angle, operating said vehicle computer model with said new steering wheel angle {Fig. 5, element 90, ¶0031}; and

(g) generating an output in response to said vehicle computer model and said initial steering wheel angle or said new steering wheel angle{Fig. 5, element 110, ¶0033}.

21. (Previously Presented) A method of operating a vehicle computer model having vehicle information and path information therein, said method being operable on a digital computer system and comprising the steps of:

(a) determining a plurality of steering wheel angles {Fig. 4, element 78, ¶0029}, each associated with a different time stamp and input to said vehicle computer model {Fig. 5, element 76, ¶0029}, by comparing an intended vehicle path with a look ahead point on said intended vehicle path at various times {Fig. 5, element 72, ¶0029};

(b) determining whether said vehicle computer model is understeering {Fig. 5, element 100, ¶0032} due to the front of said vehicle computer model plowing or slipping substantially forward in response to said plurality of steering wheel angles;

(c) determining whether said vehicle computer model is plowing or slipping substantially forward based on whether a yaw acceleration is greater than a predetermined threshold {Fig. 5, element 90, ¶0030, 0031};

(d) when said vehicle computer model is determined to be understeering {Fig. 5, element 100, ¶0032}, operating said vehicle computer model at one of said plurality of steering wheel angles until a later one of said plurality of steering wheel angles is determined such that said plowing or slipping substantially forward is thereby reduced {Fig. 5, element 102, ¶0032};

(e) when said plowing or slipping substantially forward is reduced by a later one of said plurality of steering wheel angles, operating said vehicle computer model with said later one of said plurality of steering wheel angles {fig. 5, element 110, ¶0033}; and

(f) generating an output in response to said vehicle computer model and said later one of said plurality of steering wheel angles {Fig. 5, element 114, ¶0033}.

VI. Grounds of Rejection to be Reviewed on Appeal

Are claims 1-3, 7-12, and 16-29 patentable under 35 U.S.C. §103(a) over U.S. Patent No. 6,859,713 to Pallot?

VII. Argument

Rejection of Claims 1-3, 7-12 and 16-29 under 35 U.S.C. §103(a)

Independent Claims 1, 12, and 21of the present invention are directed to a system and method of simulating the dynamics of an automotive vehicle. Understeering occurs when a vehicle does not respond to a change in the steering wheel angle. According to the inventive subject matter, when the computer model is deemed to be understeering, the initial steering wheel angle is maintained. Therefore, the computer model continues to operate with understeer using the initial steering wheel angle until a new steering wheel angle is determined and input. It is respectfully asserted that this is significantly different than the teachings in the Pallot reference.

As indicated in responses filed September 22, 2008, February 9, 2009 and March 6, 2009, Applicants assert that the present invention teaches, and claims in claim 1(ii)(d), claim 12(e); that when the vehicle computer model is determined to be understeering, the vehicle computer model is operated with the initial steering wheel angle until a new steering wheel angle is determined such that plowing or slipping is reduced, and in claim 21(d); that when the vehicle computer model is determined to be understeering, operating the vehicle computer model at one of a plurality of steering wheel angles until a later one of the plurality of steering wheel angles is determined such that plowing or slipping forward is thereby reduced.

It has been asserted, in the responses filed 2/9/09 and 3/6/09 that the Pallot reference does not teach or disclose determination of understeer as claimed in the present invention. At Column 8, line 35 to Column 9, line 8, the Pallot reference describes the phenomenon of tire saturation and the events that may occur when

tire saturation takes place. The Pallot reference teaches identification of a limit for axle force deemed to be the point at which tire saturation may occur. The Pallot reference describes that a result of tire saturation may be "one or more of the axles becoming incapable of developing the expected cornering force, and the vehicle will over steer or understeer depending on whether the saturation involves the rear axle or the front axle."

It is respectfully asserted that the Pallot reference teaches identifying tire saturation and only discloses understeer as a possible result of the occurrence of tire saturation, yet Pallot does not teach or disclose making a determination of understeer as claimed in the present invention.

Furthermore, it is respectfully asserted that the Pallot reference teaches and discloses, at Column 8, lines 21-24, imposing a corrective mechanism to compensate for tire forces before tire saturation can occur.

The teachings of the Pallot reference, particularly at column 8, lines 40-43, describe that upon reaching the axle limit, which is set to occur before tire saturation is reached, an anti-rolling force is applied by redistributing load among the vehicle's axles, thereby preventing tire saturation and ultimately avoiding any potential for understeer as a result of tire saturation to occur.

According to the teachings and claims of the present invention, the computer model determines understeer due to the front of the vehicle computer model plowing or slipping substantially forward in response to a new steering wheel angle. This means that according to the teachings of the present invention, understeer has occurred and has been detected. The teachings and claims of the present invention also require maintaining the initial steering wheel angle, (i.e., the angle associated with the understeer condition) until a new steering wheel angle is

determined and input. Understeering is allowed to occur until a new steering wheel angle is determined and input. It is respectfully asserted that this is significantly different than the teachings in the Pallot reference. The Pallot reference teaches detecting an axle limit threshold value and applying compensation to avoid tire saturation. The present invention teaches and claims determining understeer and allowing the understeer condition to remain until which point in time a new steering wheel angle is determined and input. The present invention purposely allows understeer to occur as a means to provide meaningful data from steering simulations. See the Specification as filed at ¶0011.

In the Advisory Action filed February 18, 2009 the Examiner asserted that in the Pallot reference at Column 8, lines 21-24, the "avoiding of understeering" does not mean that the understeering has not begun and instead it means that corrective action is taken when the onset of understeering is detected, and that understanding is thus avoided.

Applicants respectfully disagree with this assessment of the Pallot reference. Pallot teaches detecting an axle limit that is set to a value that is reached before the onset of tire saturation (See Column 8, lines 60-67). The reference does not teach determining understeer as claimed in the present invention. Further the Pallot reference teaches imposing the corrective action before the onset of tire saturation, which would prevent the occurrence of understeer altogether.

The Examiner also asserted that it was unclear how corrective action in Pallot could be taken if the onset of understeering is not detected. Applicants assert that because the Pallot reference is not directed to detecting understeer and is directed to detecting axle limit, no understeering is detected. The Pallot reference teaches detecting an axle limit that indicates the onset of tire saturation and applies

corrective measures upon detection of the axle limit. In this regard Pallot teaches that corrective action to avoid tire saturation is taken before any onset of tire saturation, which implies corrective action is taken before any understeer may occur as a result of tire saturation.

It is respectfully asserted that the Pallot reference is not directed to detecting understeering and therefore cannot possibly presuppose a model of understeer as asserted by the Examiner. It is respectfully asserted that the Pallot reference presupposes a model of tire saturation and not a model of understeering as claimed in the present invention.

Conclusion

The present invention teaches and claims determining understeer and allowing the understeer condition to remain by operating the vehicle computer model with the initial steering wheel angle until which point in time a new steering wheel angle is determined and input. It is respectfully asserted that is neither taught nor suggested by the Pallot reference. It is respectfully asserted that Claims 1-3, 7-12, and 16-29 are patentable under 35 U.S.C. §103(a).

It is respectfully requested that the rejection of claims 1-3, 7-12 and 16-29 be withdrawn and a notice of allowance issue therefor.

Please charge Deposit Account 06-1510 the statutory fee for filing this document as required by 37 CFR 1.17(c).

Respectfully submitted,

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VIII. Claims Appendix

1. (Previously Presented) A simulation system for simulating operation of an automotive vehicle, said simulation system comprising:

(i) an input device for providing vehicle information and path information; and

(ii) a controller coupled to said input device and operable to simulate said automotive vehicle using a vehicle computer model, wherein said controller is programmed to:

(a) determine an initial steering wheel angle that is input to said vehicle computer model;

(b) determine a new steering wheel angle, which is input to said vehicle computer model at a time later than said initial steering wheel angle, by comparing an intended vehicle path with a look ahead point on said intended vehicle path;

(c) determine whether said vehicle computer model is understeering due to the front of said vehicle computer model plowing or slipping substantially forward in response to said new steering wheel angle;

(d) when said vehicle computer model is determined to be understeering, operate said vehicle computer model with said initial steering wheel angle until a new steering wheel angle is determined such that said plowing or slipping substantially forward is thereby reduced;

(e) when said plowing or slipping substantially forward is reduced by a new steering wheel angle, operate said vehicle computer model with said new steering wheel angle; and

(f) generate an output in response to said vehicle computer model and said initial steering wheel angle or said new steering wheel angle.

2. (Previously Presented) A simulation system as set forth in claim 1, wherein said simulation system further comprises and output device that is coupled to said controller, and said controller is operable to control said output device in response to said vehicle computer model and said initial steering wheel angle or said new steering wheel angle.

3. (Previously Presented) A simulation system as set forth in claim 1, wherein said vehicle computer model comprises a dynamic control model.

4-6. (Cancelled)

7. (Previously Presented) A simulation system as set forth in claim 1, wherein said controller is operable to determine an increasing steering wheel angle by comparing said initial steering wheel angle with said new steering wheel angle.

8. (Previously Presented) A simulation system as set forth in claim 1, wherein said controller is operable to determine a decreasing steering wheel angle by comparing said new steering wheel angle with said initial steering wheel angle or a previously determined new steering wheel angle, and said controller is operable to determine a reduction in said plowing or slipping substantially forward in response to said decreasing steering wheel angle.

9. (Previously Presented) A simulation system as set forth in claim 1, wherein both said initial steering wheel angle and said new steering wheel angle are referenced by said controller from a zero steering wheel angle defined at

said front of said vehicle computer model, and said controller is operable to determine a reduction in said plowing or slipping substantially forward in response to a decrease in the absolute value of said new steering wheel angle as compared to said initial steering wheel angle or a previously determined new steering wheel angle.

10. (Previously Presented) A simulation system as set forth in claim 1, wherein both said initial steering wheel angle and each said new steering wheel angle are referenced by said controller from a zero steering wheel angle defined at said front of said vehicle computer model, and said controller is operable to determine when said vehicle computer model is plowing or slipping substantially forward in response to (i) a determined yaw acceleration being greater than a predetermined threshold and (ii) a determined increase in the absolute value of said new steering wheel angle as compared to said initial steering wheel angle or a previously determined new steering wheel angle.

11. (Previously Presented) A simulation system as set forth in claim 1, wherein said controller is operable to determine the steering wheel angle difference between said new steering wheel angle and said initial steering wheel angle or a previously determined new steering wheel angle, and said controller is operable to determine a reduction in said plowing or slipping substantially forward if said steering wheel angle difference is less than a predetermined tolerance.

12. (Previously Presented) A method of operating a vehicle computer model having vehicle information and path information therein, said method being operable on a digital computer system and comprising the steps of:

(a) determining an initial steering wheel angle that is input to said vehicle computer model;

(b) determining a new steering wheel angle, which is input to said vehicle computer model at a time later than said initial steering wheel angle, by comparing an intended vehicle path with a look ahead point on said intended vehicle path;

(c) determining whether said vehicle computer model is understeering due to the front of said vehicle computer model plowing or slipping substantially forward in response to said new steering wheel angle;

(d) determining whether said vehicle computer model is plowing or slipping substantially forward based on whether a yaw acceleration is greater than a predetermined threshold and also whether said new steering wheel angle is greater than said initial steering wheel angle or a previously determined new steering wheel angle;

(e) when said vehicle computer model is determined to be understeering, operating said vehicle computer model with said initial steering wheel angle until a new steering wheel angle is determined such that said plowing or slipping substantially forward is thereby reduced;

(f) when said plowing or slipping substantially forward is reduced by a new steering wheel angle, operating said vehicle computer model with said new steering wheel angle; and

(g) generating an output in response to said vehicle computer model and said initial steering wheel angle or said new steering wheel angle.

13-15. (Cancelled)

16. (Previously Presented) A method as set forth in claim 12, wherein step (d) is at least partially accomplished by comparing said initial steering wheel angle with said new steering wheel angle.

17. (Previously Presented) A method as set forth in claim 12, said method further comprising the steps of:

determining a decreasing steering wheel angle by comparing said new steering wheel angle with said initial steering wheel angle or a previously determined new steering wheel angle; and

operating said controller to determine a reduction in said plowing or slipping substantially forward in response to said decreasing steering wheel angle.

18. (Previously Presented) A method as set forth in claim 12, said method further comprising the steps of:

operating said controller so as to reference both said initial steering wheel angle and said new steering wheel angle from a zero steering wheel angle defined at said front of said vehicle computer model; and

operating said controller to determine a reduction in said plowing or slipping substantially forward in response to a decrease in the absolute value of said new steering wheel angle as compared to said initial steering wheel angle or a previously determined new steering wheel angle.

19. (Previously Presented) A method as set forth in claim 12, said method further comprising the steps of:

operating said controller so as to reference both said initial steering wheel angle and each said new steering wheel angle from a zero steering wheel angle defined at said front of said vehicle computer model; and

operating said controller to determine when said vehicle computer model is plowing or slipping substantially forward in response to (i) a determined yaw acceleration being greater than a predetermined threshold and (ii) a determined increase in the absolute value of said new steering wheel angle as compared to said initial steering wheel angle or a previously determined new steering wheel angle.

20. (Previously Presented) A method as set forth in claim 12, said method further comprising the steps of:

operating said controller to determine the steering wheel angle difference between said new steering wheel angle and said initial steering wheel angle or a previously determined new steering wheel angle; and

operating said controller to determine a reduction in said plowing or slipping substantially forward if said steering wheel angle difference is less than a predetermined tolerance.

21. (Previously Presented) A method of operating a vehicle computer model having vehicle information and path information therein, said method being operable on a digital computer system and comprising the steps of:

(a) determining a plurality of steering wheel angles, each associated with a different time stamp and input to said vehicle computer model, by comparing an intended vehicle path with a look ahead point on said intended vehicle path at various times;

(b) determining whether said vehicle computer model is understeering due to the front of said vehicle computer model plowing or slipping substantially forward in response to said plurality of steering wheel angles;

(c) determining whether said vehicle computer model is plowing or slipping substantially forward based on whether a yaw acceleration is greater than a predetermined threshold;

(d) when said vehicle computer model is determined to be understeering, operating said vehicle computer model at one of said plurality of steering wheel angles until a later one of said plurality of steering wheel angles is determined such that said plowing or slipping substantially forward is thereby reduced;

(e) when said plowing or slipping substantially forward is reduced by a later one of said plurality of steering wheel angles, operating said vehicle computer model with said later one of said plurality of steering wheel angles; and

(f) generating an output in response to said vehicle computer model and said later one of said plurality of steering wheel angles.

22. (Previously Presented) A method as set forth in claim 21, wherein step (a) is at least partially accomplished by determining said plurality of steering wheel angles periodically.

23. (Previously Presented) A method as set forth in claim 21, wherein said yaw acceleration is a normalized yaw acceleration.

24. (Previously Presented) A method as set forth in claim 23, wherein said normalized yaw acceleration is a steering wheel angle normalized yaw acceleration.

25. (Previously Presented) A method as set forth in claim 21, said method further comprising the step of providing said output to at least one

output device selected from the group consisting of a computer screen, a computer printer, a computer disk drive, and a compact disc (CD) read-only memory (ROM) drive.

26. (Previously Presented) A method as set forth in claim 21, said method further comprising the steps of:

determining a decreasing steering wheel angle by comparing a later one of said plurality of steering wheel angles with an earlier one of said plurality of steering wheel angles; and

operating said controller to determine a reduction in said plowing or slipping substantially forward in response to said decreasing steering wheel angle.

27. (Previously Presented) A method as set forth in claim 21, said method further comprising the steps of:

operating said controller so as to reference both an earlier one of said plurality of steering wheel angles and a later one of said plurality of steering wheel angles from a zero steering wheel angle defined at said front of said vehicle computer model; and

operating said controller to determine a reduction in said plowing or slipping substantially forward in response to a decrease in the absolute value of said later one of said plurality of steering wheel angles as compared to said earlier one of said plurality of steering wheel angles.

28. (Previously Presented) A method as set forth in claim 21, said method further comprising the steps of:

operating said controller so as to reference both an earlier one of said plurality of steering wheel angles and a later one of said plurality of new steering

wheel angles from a zero steering wheel angle defined at said front of said vehicle computer model; and

operating said controller to determine whether said vehicle computer model is plowing or slipping substantially forward in response to a determined increase in the absolute value of said later one of said plurality of steering wheel angles as compared to said earlier one of said plurality of steering wheel angles.

29. (Previously Presented) A method as set forth in claim 21, said method further comprising the steps of:

operating said controller to determine the steering wheel angle difference between said later one of said plurality of steering wheel angles and said earlier one of said plurality of steering wheel angles; and

operating said controller to determine a reduction in said plowing or slipping substantially forward if said steering wheel angle difference is less than a predetermined tolerance.

IX. Evidence Appendix

There is no Evidence Appendix herein.

X. Related Proceedings Appendix

10/707,368 an Appeal Brief was filed 7/23/07 and the board has yet to render its decision.

10/707,366 an Appeal Brief was filed 6/22/09 and the board has yet to render its decision.